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6/1/2024

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The Space and Time of Classical Physics

In this first chapter we will discuss how Euclidean geometry, despite its 2300 years of age and its re-elaborations (mainly due to Hilbert) in the twentieth century, provides a perfect mathematical description of the space and time of classical Physics. By this we are referring to the physical space and the physical time as they appear to any possible observer, thought of as a collection of instruments (without necessarily being sentient). In the last section, where we extend the notions introduced previously, we will arrive at the concept of differentiable manifold, which will be useful in the rest of the book.

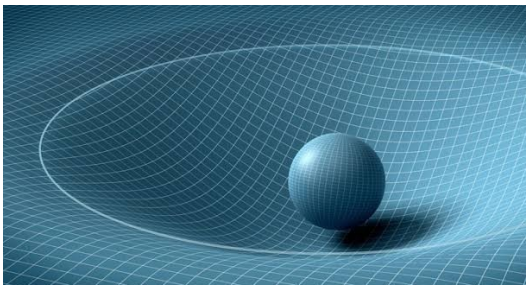


Figure 1: Space and Time

Equations of motion

Suppose that the trajectory of motion of a Planet around the Sun lies in the plane. Both the Planet as well as the Sun will be regarded as material points. Let attach a coordinate frame at the center of the Sun, and describe the position of the Planet with respect to the Sun using the Cartesian coordinates (x, y) T , see Figure 1. Let M denote the mass of the Sun, and m the mass of the Planet.

In order to formulate equations of motion of the Planet we shall invoke the 2nd Newton's Principle of Dynamics, ma = F

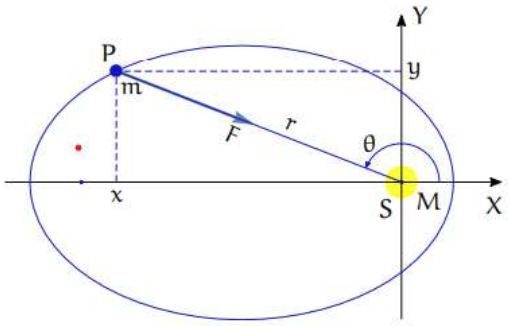
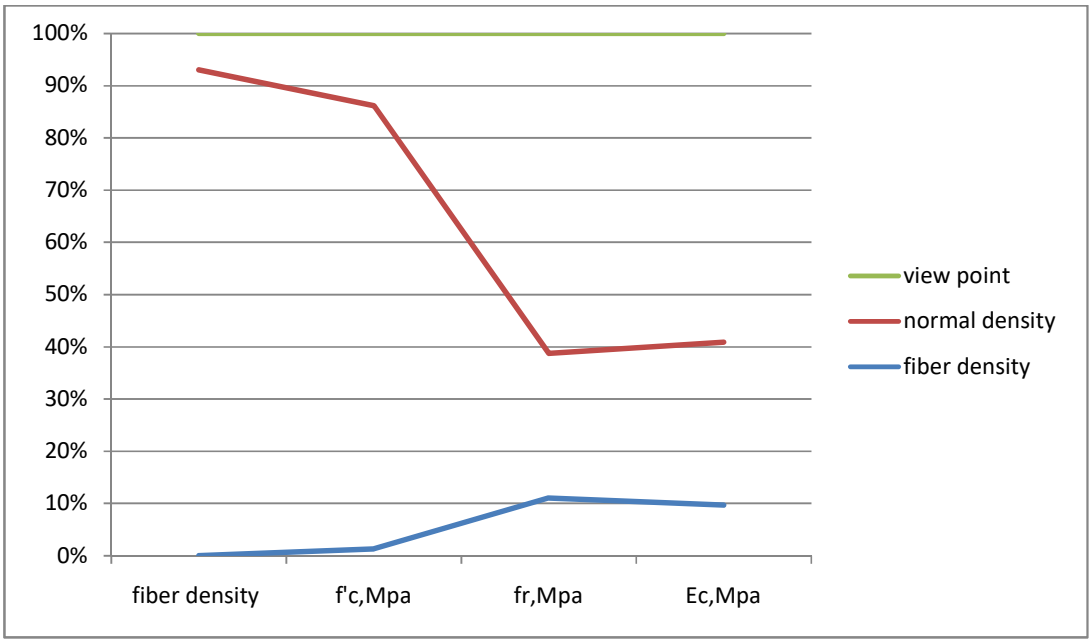


Figure 1: Position of the Planet around the Sun

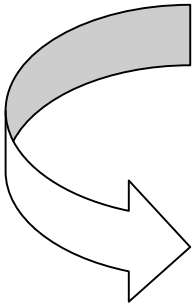
Moment of inertia

The moment of inertia, otherwise known as the mass moment of inertia, angular/rotational mass, second moment of mass, or most accurately, rotational inertia, of a rigid body is a quantity that determines the torque needed for a desired angular acceleration about a rotational axis, akin to how mass determines the force needed for a desired acceleration. It depends on the body's mass distribution and the axis chosen, with larger moments requiring more torque to change the body's rate of rotation by a given amount.

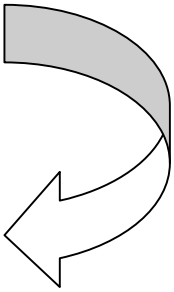
Stress and stress chart



Direction



anti clock-wise direction



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